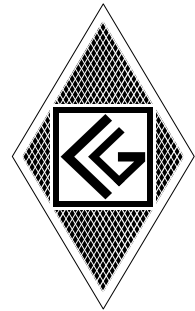


XR1-E

Ring Modulation Oscillator Analog Effect Device



Berlin 2015

The *XR1-E* is an analog ring modulator device with internal oscillator, suitable for instrument or microphone input.

The oscillator frequency is adjustable by manual control (coarse and fine) over a wide range. In addition, it can be modulated by an internal LFO (low frequency oscillator) and/or an envelope follower. If applied, an external CV (control voltage) or pedal may be also used for frequency modulation. Original and effect signal are miscible, but the *XR1-E* also provides a footswitch input for external switching between effect and original. In this case, the *XR1-E* provides *true bypass* routing.

Further, the ability of battery operation makes the device independent from external power supply (6x AA mignon cells).

The *XR1-E* is based on a function generator chip, which warm and smooth sound makes it excellently suitable for electronic music and ring modulation.

- ◆ Low noise preamp
- ◆ Ring modulation oscillator frequency range:
 - ◆ High: 8Hz - 18000 Hz
 - ◆ Low: 0.15Hz - 60Hz
- ◆ Envelope follower and LFO for frequency modulation
- ◆ Frequency CV input (1V/oct adjustable), also suitable for pedal use
- ◆ Optional footswitch control (true bypass)
- ◆ Battery operation or external DC power supply (wide voltage range: 6-15V)
- ◆ Power dissipation: ca 600mW (operation time with zinc-carbon cells ca. 6-10h)



Quick start guide

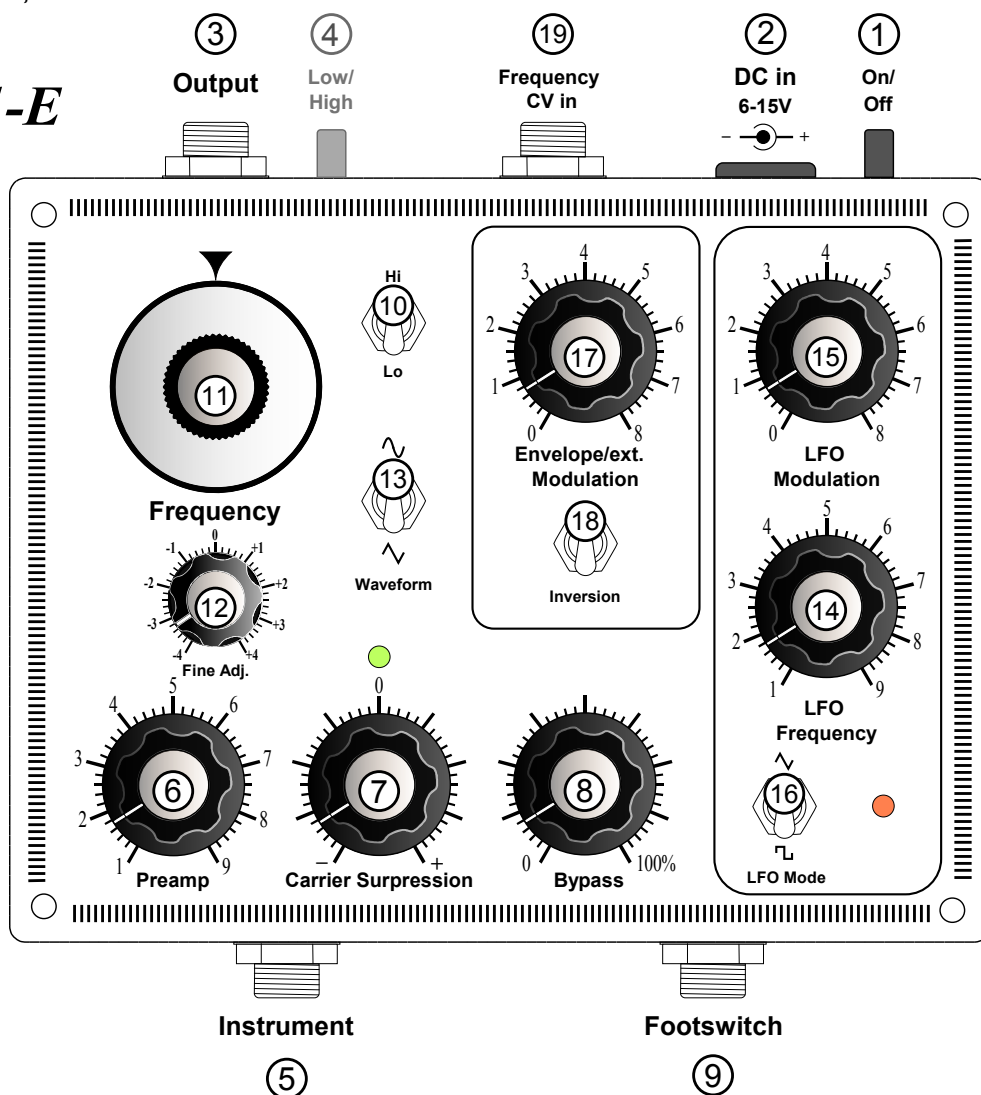
1. Insert batteries or accu (6x AA Mignon) or connect a power adaptor ②. Set the power switch ① upwards to "On". Connect an amplifier, mixer etc. to the output ③. Connect an instrument or microphone to the instrument input ⑤.
2. Set the frequency selector switch ⑩ on "Hi". Turn the "Frequency" knob ⑪ in middle position. Turn the bypass pot ⑧ in fully right position : "100%". Turn the envelope and LFO modulation knobs ⑬, ⑮ in fully left position: "0".
By calibrating the "Carrier Suppression" pot ⑦ while listening to the oscillator tone, adjust the tone to its minimum ($\approx$ "0" on the scale/ denter locked; you may also use the green LED for indication).

Adjust the "Preamp" input gain controller ⑥ while playing your instrument and listen for optimal performance.

NOTE: It is not possible to eliminate the carrier (oscillator) tone completely. There will always remain some overtone frequencies. Try to set the input pot ⑥ on a high level (but without distortion) to achieve best operation.

3. With this basic settings it is easy to experiment further on, e.g. with different oscillator frequencies ⑩, ⑪, ⑫; by adding some frequency modulation with the LFO: ⑭ for LFO speed and ⑮ for modulation depth, or by activating the envelope modulation by turning knob ⑬ clockwise, etc..

XR1-E



A continuous, repeating sawtooth wave pattern, consisting of a series of sharp, upward-pointing peaks and downward-pointing valleys, resembling a zigzag line.

① On/Off Switch

Switches the power supply on or off.

*Note: In combination with an external power adaptor only the **XR1-E** will be switched off and not the power adaptor itself. This means that the power adaptor still may consume some current for its own ("stand-by"). It is recommended to disconnect the adaptor completely from public power supply if the **XR1-E** is not in use for a of longer time .*

② External Power Supply Input

Allows the operation with an external standard DC power adaptor. The connection is a standard DC plug with 2.1mm diameter hole. By using the external power supply input ②, the internal batteries will be switched off. The input voltage range is 6V – 15V. Max. current dissipation is ca. 100mA (at 9V: $\approx 70\text{mA}$). Take care on right polarity: The "+" pole is the outer contact.

③ Output

Connection to the following stage, e.g. an amplifier.

④ (Only previous version Rev1) Output Attenuator Switch

High: max. 8Vpp output voltage made for analog synthesizer inputs, line-in (mixer) inputs etc..

Low: max. 0.8Vpp output voltage for instrumental amplifier inputs etc.

This switch only exists in the XR1-E's previous version Rev1. Due to the new *true bypass* feature in the actual version Rev2, this switch is no longer useful.

⑤ Instrument Input

Input jack for instrument or microphone. Impedance: ca 380k Ω ; max. input voltage: $\leq 3.5V_{pp}$.

⑥ Preamp Gain Control

Adjustment of the the input preamp's amplification for the instrument input ⑤ . The preamp is feeding the oscillator's amplitude modulation input. It is necessary to adjust the preamplification properly for best performancy. The input signal should be not distorted, but also not too soft for the best effect-to-noise ratio.

⑦ Carrier Suppression Control

Controller for calibrating the oscillator (carrier) tone to its minimum. The "0" position in the middle of the scale / the potentiometer's center locked may be used as reference point, as well as the green LED – when dark (and without input signal) – is suitable for indication of a minimum carrier tone amount.

Note: There will always remain a little bit of the oscillator sound (2nd harmonics etc.). For best performance, make sure that the input signal level is high.

⑧ Bypass Control

Ratio between input signal (preamplified) and effect signal. Turning the knob fully left will provide the preamplified input signal only; by turning the knob clockwise the effect signal will increase more and more and the original (dry) signal will disappear. Fully right position = "100%": the pure ring modulation effect signal.



⑨ Footswitch Input

Input jack for external bypass (dry/wet) control, e.g. by a footswitch

- Switch closed: The dry original input signal (*true bypass*)
- Switch opened: The effect signal (also depending on position of the "Bypass" control knob ⑧)

The switching also can be controlled by an external logic signal (0V = effect, +5V = dry), e.g. a gate signal from a synthesizer.

⑩ Oscillator Frequency High/Low Switch

Hi: $\approx 8\text{Hz} - 18000\text{Hz}$ (Audio range)

Lo: $\approx 0.15\text{Hz} - 60\text{Hz}$

In "Hi" position, the oscillator is mainly working in audio range. The amplitude modulation will generate additional audio frequencies – sum and difference tones of the input signal and the oscillator frequency.

In "Lo" position, the oscillator is working with subaudio frequencies. The amplitude modulation result is a tremolo-like sound. Volume of the input signal will change constantly with the oscillator frequency.

⑪ Oscillator Frequency Control

Coarse adjustment of the amplitude modulation (AM) oscillator frequency.

⑫ Oscillator Frequency Fine Adjustment Control

Fine tuning of the oscillation frequency. Range is about 4 – 5 semitones (quarte).

⑬ Oscillator Waveform Switch

The oscillator waveform can be selected between sinewave and triangle. In "∧" (sine) position, the effect is a more smooth sound with less overtones; in "∨" (triangle) mode the generated sounds are rougher and with more overtones.

⑭ LFO Frequency Control

Speed control of the internal LFO (low frequency oscillator) for frequency modulation of the ring modulation oscillator. Frequency is from $\approx 0.06\text{Hz}$ (left position) to $\approx 44\text{Hz}$ (right position)

The LFO frequency is also displayed by the orange LED for visual control.

⑮ LFO Modulation Depth Control

Amount of LFO modulation depth

⑯ LFO Waveform Switch

The LFO waveform can be selected between triangle ("∧") and square ("□"). "∧" will provide a continuously up-and down gliding pitch, while "□" makes the oscillator shifting between two tones.

⑰ Envelope Follower/ext. CV Modulation Depth Control

The internal envelope follower converts the volume of the input signal on the instrument input ⑤ into a control voltage modulating the oscillator frequency. Amount of modulation can be varied by this knob.

If the external frequency CV (= Control Voltage) input ⑲ is used, the internal envelope follower will be switched off; instead the signal on ⑲ can be adjusted by this pot (frequency modulation depth).





⑱ Envelope Follower Modulation: Inversion Switch

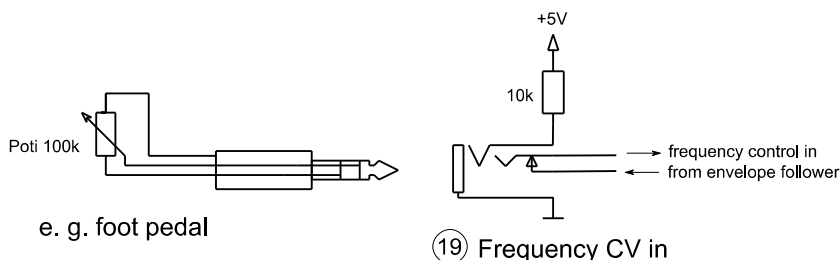
Switches the modulation polarity (from envelope follower or an external source on ⑲) from positive to negative. If the switch is in upper position, the pitch of the AM oscillator will increase with higher volume of the input signal. switch in lower position (= "Inversion") the pitch will decrease with higher input volume. The inversion switch works also for a control voltage signal connected to ⑲.

⑲ External Frequency Control Input

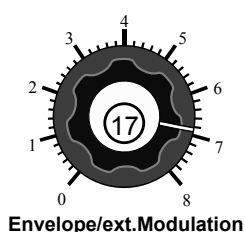
Allows to control the oscillator pitch by an external control voltage (CV) or an external resistor. By connecting a jack to this input, the internal envelope follower will be shut off and instead the fed in control voltage will modulate the oscillator's frequency; the modulation depth can be adjusted by knob ⑰.

The modulation CV's polarity can be inverted by switch ⑱. Normally, a higher voltage will cause a higher pitch and vice versa. With ⑱ in lower position ("Inversion") a higher voltage will cause a decreasing pitch and vice versa.

Further, a +5V DC voltage (via 10kΩ resistor) is provided on ⑲, available on the middle connector of a 3pole jack plugged in ⑲. Thus may be useful, for example, in combination with a sensor or a pedal. In the latter case, a common passive foot pedal with 3pole jack should work.



In combination with analog synthesizer equipment (e.g. sequencers, monophone keyboards), it is possible to calibrate the **XRI-E** on 1V/Oct. by adjusting knob ⑰.



To calibrate on 1V/Oct for tracking with other instruments, connect the external CV source to ⑲ and set the pointer of the "Envelope/ext.Modulation" controller ⑰ to nearby "7" on the scale. This is a good base. Then adjust by listening with different CV values until the pitch matches with the pitch of your instrument.



About Ring Modulation

Ring modulation is the multiplication of two bipolar audio signals by each other. Each value of a carrier signal, C , is multiplied by a modulator signal, M , to create a new *ring-modulated* signal, R :

$$R(t) = C(t) \times M(t)$$

(from: http://en.wikibooks.org/wiki/Sound_Synthesis_Theory/Modulation_Synthesis)

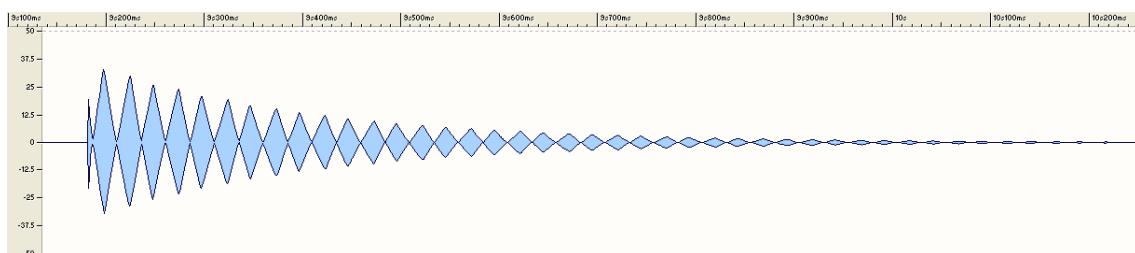
It is referred to as "ring" modulation because the analog circuit of diodes originally used to implement this technique took the shape of a ring ([Wikipedia](http://en.wikipedia.org/wiki/Ring_modulation)).

For example: If one or both of the input signals C or M is 0V, the output R will be also 0V.

Note: In the case of the XR1-E the carrier signal is $\wedge$ or $\vee$, provided by the internal oscillator.

Examples

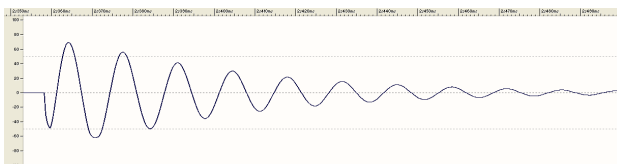
Input (=modulator) signal frequency >> oscillator (carrier) frequency ($\wedge$):



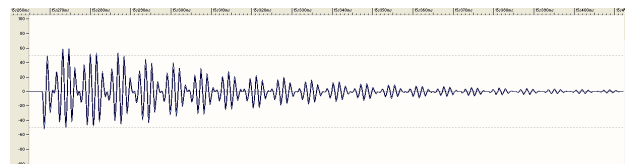
Input signal: metallophone

The volume of the metallophone sound varies with the oscillator amplitude.

Input (=modulator) signal frequency << oscillator (carrier) frequency ($\wedge$)



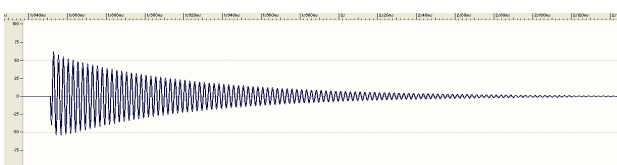
Input signal: "Base drum" from rhythm machine



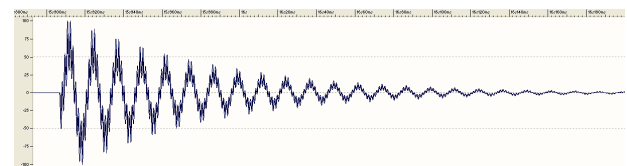
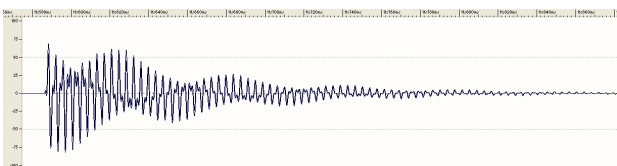
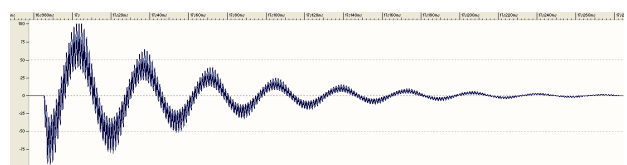
The generated effect signal

The volume of the oscillator sound varies with the amplitude of the input signal

Input (=modulator) signal frequency $\leq$ or $\geq$ oscillator (carrier) frequency ($\wedge$)



Input signal: "Mid tom" from rhythm machine



Complex sound structures are generated, depending on the oscillator frequency.



Support

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This documentation is for **XR1-E Rev.2**

For the previous version (with output high/low switch ④ and without *true bypass*) see here:
www.cg-products.de/XR1-E_documentation_Rev1.pdf

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